

COUNTERMEASURES TO ENHANCE SENSORIMOTOR ADAPTABILITY

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During exploration-class missions, sensorimotor disturbances may lead to disruption in the ability to ambulate and perform functional tasks during the initial introduction to a novel gravitational environment following a landing on a planetary surface. The goal of our current project is to develop a sensorimotor adaptability (SA) training program to facilitate rapid adaptation to novel gravitational environments. We have developed a unique training system comprised of a treadmill placed on a motion-base facing a virtual visual scene that provides an unstable walking surface combined with incongruent visual flow designed to enhance sensorimotor adaptability. We have conducted a series of studies that have shown:

- Training using a combination of modified visual flow and support surface motion during treadmill walking enhances locomotor adaptability to a novel sensorimotor environment.
- Trained individuals become more proficient at performing multiple competing tasks while walking during adaptation to novel discordant sensorimotor conditions.
- Trained subjects can retain their increased level of adaptability over a six months period.
- SA training is effective in producing increased adaptability in a more complex over-ground ambulatory task on an obstacle course. This confirms that for a complex task like walking, treadmill training contains enough of the critical features of overground walking to be an effective training modality.
- The structure of individual training sessions can be optimized to promote fast/strategic motor learning. Training sessions that each contain short-duration exposures to multiple perturbation stimuli allows subjects to acquire a greater ability to rapidly reorganize appropriate response strategies when encountering a novel sensory environment.
- Individual sensory biases (i.e. increased visual dependency) can predict adaptive responses to novel sensory environments suggesting that customized training prescriptions can be developed to enhance adaptability.

These results indicate that SA training techniques can be added to existing treadmill exercise equipment and procedures to produce a single integrated countermeasure system to improve performance of astro/cosmonauts during prolonged exploratory space missions.

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